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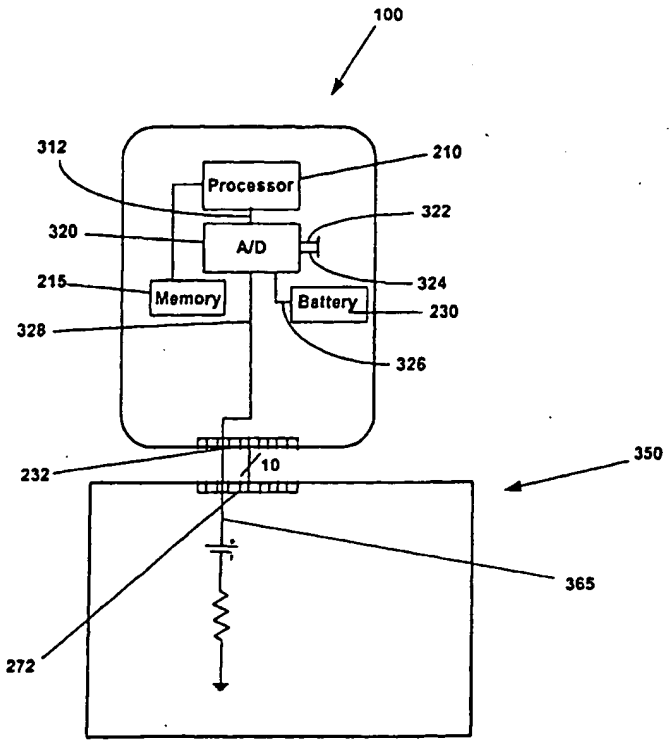
(57) Abstract

Embodiments of this invention provide for detecting a type of an accessory device connected to a portable computer. The portable computer may detect a signal from the accessory device and determine the type of accessory device using the signal. Once the type of accessory is identified, the portable computer may implement a software that matches the particular type of accessory. The type of accessory may be identified by measuring a voltage of a signal line that is coupled to the accessory device. The value of the voltage on the signal line may then be matched to a corresponding accessory type using a memory of the portable computer.



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SYSTEM AND METHOD FOR DETECTION OF AN ACCESSORY DEVICE CONNECTED TO A PORTABLE COMPUTER

BACKGROUND OF THE INVENTION

Field of the Invention

This invention pertains to a portable computing device. More specifically, embodiments of this invention provide for detecting and/or determining a type of an accessory device connected to a portable computing device.

Description of the Related Art

Portable computers such as laptop and handheld computers may be provided with additional capabilities through the use of accessory devices. The accessory devices may electrically couple to a processor of the portable computer to provide communication capabilities and external power. Accessory devices in general have been used to add functions and resources to portable computers to compensate for inherent limitations arising from their size and mobility. Previous accessory devices have been used to provide, among other things, an alternating current (A/C) supply, serial and parallel ports, modems, additional memory, and universal serial ports. The portable computer may use accessory devices to communicate with larger computers and data networks.

Portable computers are typically equipped with a time-out feature that turns the computer off after a predetermined duration of inactivity. The time-out feature is designed to preserve battery life. While the time-out feature may be necessary when the portable computer is operating from an internal battery source, accessory devices may supply an A/C converter to the portable computer to eliminate the need for the time-out feature. However, previous portable computers provide for the time-out feature to be enabled so that the portable computer switches off after a period of inactivity, even if the accessory device is supplying external power. Still, other portable computers, such as Zaurus™ personal digital assistant manufactured by the Sharp Corp. and PalmPilot™ organizers manufactured by the 3Com Corp., disable the time-out

feature only when an A/C power adapter is supplied to a power terminal of the portable computer.

These devices do not disable the time-out feature when an accessory device such as a communication cradle is connected to the portable computer through a communications port. In such instances, the time-out feature can be limiting and a nuisance to the user by precluding, for example, use of programs that require minimal user interaction. Therefore, there is a need for enabling the portable computer to detect whether an accessory device supplying external power is actively connected to the portable computer.

Furthermore, a number of different types of accessories are available for use with portable computers. However, previous portable computers are not equipped to automatically determine the type of accessory device that is actively connected to the portable computer. Without this ability, the user is required to perform additional software functions to identify the particular accessory device for the portable computer. In addition, the portable computer may accidentally execute an application for an accessory device other than the one being used. In certain applications, this can be harmful to the portable computer and/or the accessory device. For example, the PalmPilot III™ may access a modem accessory device by executing a software application configured only for modem devices. In some instances, the software application may be damaging if the accessory device connected to the portable computer is erroneously identified as a modem device. Therefore, there is a need for enabling the portable computer to automatically determine the type of the accessory actively connected to it.

These and other shortcomings of previous portable computers will be addressed by various embodiments of this invention.

SUMMARY OF THE INVENTION

Embodiments of this invention provide for detecting a type of an accessory device connected to a portable computer. The portable computer may detect a signal from the accessory device and determine the type of accessory device using the signal. Once the type of accessory is identified, the portable computer may implement a software that matches the particular type of

accessory. The type of accessory may be identified by measuring a voltage of a signal line that is coupled to the accessory device. The value of the voltage on the signal line may then be matched to a corresponding accessory type using a memory of the portable computer. Examples of accessories for use with embodiments of this invention include a modem device, a serial communication cradle, and a Universal Serial Bus (USB) cradle.

An embodiment of this invention uses only a single line in a communications or am output port to detect any one of multiple types of accessory devices. This provides a simple and effective way to differentiate between accessory devices that are coupled to the portable computing device.

BRIEF DESCRIPTION OF THE FIGURES

FIG. 1 illustrates a portable computing device that may incorporate an embodiment of the invention.

FIG. 2 is a schematic of an embodiment of this invention for detecting an accessory device actively connected to a portable computing device.

FIG. 3 is an embodiment of this invention for detecting a type of an accessory device connected to the portable computing device.

FIG. 4A is another embodiment of this invention for detecting a type of an accessory device connected to the portable computing device.

FIG. 4B is another embodiment of this invention for detecting a type of an accessory device connected to the portable computing device.

FIG. 5 is a flowchart of an algorithm for detecting a communication device actively connected to the portable computing device.

FIG. 6 is a flowchart of another algorithm for determining a type of an accessory connected to the portable computing device.

DETAILED DESCRIPTION

An embodiment of this invention provide for detecting a type of accessory device connected to a portable computer. The portable computer then implements software to accommodate the specific accessory device detected. Another embodiment of this invention provides for detecting whether a

communication accessory, such as a communication cradle, is actively connected to the portable computer. The portable computer then suspends a time-out feature, as the communication device supplies external power to the portable computer.

This disclosure initially describes a portable computer and accessory device for use with various embodiments of the invention, including user features of the portable computer that may be affected or altered. In FIG. 2 and accompanying text, the disclosure describes hardware for detecting whether an accessory device is connected to the portable computer. In FIGS. 3, 4A, and 4B and text accompanying these figures, the disclosure describes embodiments for detecting the type of accessory device connected to the portable computer. In FIG. 5 and accompanying text, an algorithm is presented for detecting whether the accessory device is actively connected to the portable computer. In FIG. 6 and accompanying text, an algorithm is described for detecting an accessory type connected to the portable computer.

In an embodiment of this invention, the portable computer includes three modes of operation. For purpose of this disclosure, an "on-mode" is a mode in which a processor of the portable computer is fully operational. A "doze-mode" is a mode in which a processor is operating fewer functions to conserve energy. For example, in the doze-mode, a display may be on, but a user may experience a pause between the time an input in entered and processed. In the "sleep-mode", the portable computer is in its lowest state of power consumption, where the display is off and a processor is performing minimal functions such as time-keeping.

For purposes of this description, a portable computer is a combination of a processor coupled to a memory. A portable computer is a computer having a portable energy resource. Handheld computers are portable computers designed to be used with one hand.

Portable Computer and Accessory Device

With reference to FIG. 1 an embodiment of this invention includes a portable computer 100 and an accessory device. Preferably, the portable computer 100 has interactive hardware and software that perform functions such

as maintaining calendars and phone lists. The portable computer 100 shown in FIG. 1 includes a plurality of input functions keys 115 and a display 114 having graphic user interface features. The display 114 may be provided with an interface that allows the user to select and alter displayed content using a pointer such as a stylus. In an embodiment, the display 114 also includes a Graffiti™ writing section 118 for tracing alphanumeric characters as input. A plurality of application buttons 117 for performing automated or pre-programmed functions may be provided on a portion of the display 114. The portable computer 100 may also include an antenna for receiving wireless communications. An example of a suitable portable computer 100 for use with embodiments of this invention include handheld computers such as PalmPilot™, Palm III™, Palm IV™, Palm V™ organizers, manufactured by the 3Com Corporation. Other embodiments of the invention can include Windows CE™ portable computers, or other handheld computers and personal digital assistants.

The stylus for inputting information onto the display 114 may slideably mount to a rail (not shown) on one of the lateral sides 122 of the portable computer 100. In an embodiment, the rail may be provided with logic and electromechanical switches to perform functions based on the movement and position of the stylus. The rail may provide an "on/off" function, where removal of the stylus activates the portable computer 100 for user operation. For example, removal of the stylus may actuate a switch (not shown) implemented with the rail to activate the portable computer 100. The switch may be formed from an electromagnetic coupling between a metal stylus and a conductive element on the rail, where removal of the stylus forces a current. In another embodiment, a spring having a conductive surface may biasly obstruct the path of the stylus along the rail, so that removal of the stylus alters the length of the spring to close the switch.

As will be further described, the accessory device may include a plug-in communication cradle 150 having a parallel port for data transfer with a data network or another computer. Other embodiments may provide for another type of accessory device that equips the portable computer 100 with, for example, serial communication abilities as provided by a modem device or Universal

Serial Bus (USB) cradle. The communication cradle 150 includes a stand 152, and an A/C adapter 160 that extends electricity from an external socket to power the portable computer 100. The communication cradle 150 also includes one or more ports for parallel and/or serial data transfer with other computers or data networks. The portable computer 100 may use the communication cradle 150 for the purpose of downloading and uploading software, and for synchronizing data on the portable computer 100 with a personal computer (not shown, but may be included or used with some embodiments of the invention). The communication cradle 150 couples to the portable computer 100 through a connector (see FIGS. 2-4) of the stand 152. A button 155 may effectuate an electrical connection between the communication cradle 150 and the portable computer 100 when the two are connected.

In an embodiment, the portable computer 100 includes hardware and/or software to detect whether the communication cradle 150 is actively connected to the portable computer 100. One advantage provided by this embodiment is that software on the portable computer 100 may be altered and/or reconfigured to optimize functions of the portable computer 100 according to whether the accessory device is actively connected. In this way, the portable computer 100 may launch programs that are practical only when external power is available. FIG. 1 shows that the portable computer 100 may, for example, run a program to continuously display a world-clock on the display 114 when the communication cradle 150 is detected. Importantly, in this example, the type of accessory device indicates that the power is being supplied from an external source so leaving the portable computer 100 does not drain the battery.

The portable computer 100 also accommodates alternative types of accessory devices, such as a modem port or a USB cradle. An embodiment of the portable computer 100 under this invention may include resources to detect a type of accessory, and may further alter or reconfigure software to accommodate the specific accessory type without requiring user input. This feature safeguards against the portable computer 100 being prompted to execute an application for the wrong accessory device. For some accessory devices such as USB cradles, the accessory device may be damaged if the portable computer executes an application for another type of accessory device such as a modem

port. This invention provides that the portable computer 100 will run the correct application for a particular accessory type. For example, the portable computer 100 will not execute the modem application if the accessory device is a USB device or cradle. In this manner, the portable computer 100 may implement software for a particular accessory type with minimal user attention, while precluding the possibility of running a program for the wrong accessory device.

Detecting an Accessory Device

FIG. 2 is an illustrative block diagram showing additional details of an embodiment of the portable computer 100 connected to communicate with an exemplary accessory device. In the embodiment shown by FIG. 2, the accessory device is the plug-in communication cradle 150 having a parallel communication port for coupling the portable computer 100 to an external processor. The communication cradle includes an integrated A/C adapter for operating the portable computer 100 independent of an internal battery source.

With further reference to the embodiment of FIG. 2, the portable computer 100 includes a processor 210, a memory, and a battery source 230. Preferably, the processor 210 is a Motorola EZ Dragonball 328™ processor, and the memory 215 is a separate component that provides Random Access Memory (RAM). The battery source 230 internally powers the processor 210 and memory 215, as well as other electrical components within the portable computer 100. The battery source 230 may be standard disposable batteries, or rechargeable such as Lithium-ion batteries. The portable computer 100 also includes a communication port 232 having a pin connector for coupling to a mating pin connector accessible in an output port 272 of the communication cradle 150.

The processor 210 extends a signal line 205 to a pin element of the pin connector of the output port 272. The portable computer 100 and communication cradle 150 may electrically connect using only some of the pin elements of the respective pin connectors. For example, the communication port 232 may include a ten pin male connector, where nine pins are designated for functions such as parallel data transfer, parity, and "hot sync" functions for

coupling the portable computer 100 with another computer. One remaining pin is available for coupling without affecting the remaining pins. The example shown in FIG. 2 couples the available pin to the signal line 205. In one configuration, the signal line 205 and the available pin are initially pulled high using a pull-up resistor. When the pin connector is mated to electrically connect with the communication cradle 150, the pin and signal line 205 are pulled low. The change in voltage on the signal line 205 signals the processor 210 that an electrical connection between the communication cradle 150 and portable computer 100 is established. The processor 210 may then execute a program based on the accessory device being actively connected to the portable computer 100.

The programs executed by the processor 210 include certain software applications that preserve battery resources. The portable computer 100 may have a time-out feature designed to significantly reduce the power consumption of the device when the portable computer is inactive or not in use. In general, the time-out feature operates by switching the portable computer 100 from a state of high power consumption to a state of low power consumption when the portable computer detects inactivity for a predetermined duration of time.

Portable computers typically use some power at all times for the purpose of maintaining a clock, memory etc. Therefore, the portable computer 100 may include multiple states of power consumption, rather than just the "on" and "off" mode. The states of the portable computer may include the "doze-mode" in which the display 114 is powered, but some resources within the portable computer 100 have stopped. The states of the portable computer 100 may also typically include a "sleep-mode', where the portable computer 100 is consuming significantly less power, but performing a few limited functions such as maintaining the clock.

The time-out feature provides that the portable computer 100 enters a state of low power consumption such as the sleep-mode if the processor 210 is substantially inactive after a predetermined time-period. For example, the known art provides that the portable computer 100 may time-out into the sleep-mode when user activity ceases for more than two minutes. In devices such as

PalmPilot™ organizers, the time-out feature may be programmed by the user to vary between one and three minutes.

In an embodiment of the invention, a change in voltage on the signal line 205 may signal the processor 210 to alter a portion of a program and execute code for suspending or prolonging the occurrence of the time-out feature. In one embodiment of this invention, the portable computer 100 has a switch to alternatively allow the user to selectively override the normal behavior of the time-out function when the communication cradle 150 is active. The portable computer 100 may also detect the change in the voltage on the signal line 205 for the purpose of informing the user that the communication cradle 150 is actively connected.

One advantage of suspending the time-out feature includes allowing the user to continually access the portable computer 100 without having to switch it on.

Disabling the time-out feature, or otherwise modifying the time-out feature, also allows the portable computer 100 to be optimized for certain software applications that either require minimal user interface or require proportionately greater amounts of power. Examples of such applications include energy intensive software programs that have functions outside traditional function such as of maintaining a calendar and phone numbers. For example, the portable computer 100 may include software for displaying digital photographs. Suspending the time-out feature enables the portable computer 100 to be used as a picture frame. Other examples of software applications that may be launched when the portable computer 100 has access to plug-in power include games, a world clock display, or a computer desktop companion. Suspending the time-out feature may also be used to execute applications that continuously communicate with and/or display information from a data network. Such applications may be used to display information such as a stock market ticker.

In another embodiment of the invention, the change in voltage on the signal line 205 resulting from coupling the communication cradle 150 may signal the processor 210 to alter a portion of a program for suspending or prolonging a time-out for a backlight display. Previous portable computers

provide for the software control program to turn the backlight off to conserve battery power. In this embodiment, the backlight may be continuously powered when the processor 210 detects the communication cradle 150. Alternatively, the backlight can be selectively turned on or off independent of the display screen when the processor 210 determines that the communication cradle 150 is electrically connected to the portable computer 100.

By detecting whether an accessory device is actively connected, the processor 210 may also alter or reconfigure software to provide an alternative software arrangement for routine uses of the portable computer 100. For example, the processor 210 may be programmed to interpret the presence of an actively connected communication cradle 150 as representing a "home" position. In response to detecting an actively connected communication cradle 150, the processor 210 may alter or reconfigure the software to more readily accommodate a home default position. The software may, for example, be altered to redisplay a database in a new order. Accordingly, the portable computer 100 may list personal phone numbers as a default file in a menu, and list home finances as a default in a spreadsheet application, and display only "to-do" tasks such as household chores. Then, when the portable computer 100 and the accessory device are not electrically connected the processor may run software for a professional setting, including listing professional numbers and calendar items.

Detecting a Type of an Accessory Connected to the Portable Computer

FIG. 3 is a block diagram schematic of another embodiment of this invention where a portable computer is equipped to distinguish different types of accessories. In this embodiment, the portable computer 100 includes the processor 210, analog-digital (A/D) converter 320, and the battery source 230. The portable computer 100 also includes a memory 215 connected to the processor 210. The processor 210 is preferably a Motorola EZ Dragonball 328™ that is connected to the A/D converter 320 via an 8-bit connection 312. The A/D converter 320 preferably includes four channels. A first and second channel 322 and 324 of the A/D converter 320 are dedicated for display operations. A third channel 326 couples to the battery source 230. In this

embodiment, a fourth channel of the A/D converter 320 is used as a signal line 328 to extend to a communication port 232 of the portable computer 100. The A/D converter 320 couples to the battery source 230 via the third channel 326 to receive a reference voltage for a comparator (not shown) incorporated within the A/D converter 320. The communication port 232 may include a male pin connector for coupling and electrically connecting with an accessory device.

In the embodiment of FIG. 3, an accessory device 350 provides a constant voltage on an output node 365. The accessory device may be one of several devices, including the communication cradle (shown by numeral 150 in FIG. 1), modem devices and USB cradles. The output node 365 of the accessory device 350 is accessed through an output port 272 to the pin connector for the communication port 232. Previous systems provide for coupling the portable computer 100 and accessory device 350 using only some of the pin elements of the 10-pin connector. As mentioned in the embodiment of FIG. 2, the communication port 232 provides a male pin connector with nine pins designated for functions such as parallel data transfer and parity, and one pin being left available for alternative uses. Each type of accessory device may be assumed to have a unique constant voltage on a corresponding output node that is accessible by the portable computer 100 through the communication port 232. Therefore, one improvement provided by some embodiments of this invention includes coupling the available pin between the A/D converter 320 and the output node of an accessory device for the purpose of detecting and distinguishing accessory devices from each other.

In an embodiment, the A/D converter 320 receives a reference voltage from the battery source 230, and an input signal from the signal line 328 extending through the available pin of the communication port 232. The A/D converter 320 may then (1) determine whether an accessory device is actively connected to the portable computer 100 via the communication port 232, as described in FIG. 2; and/or (2) determine the type of accessory device being electrically connected to it.

The portable computer 100 and the accessory device 350 may be connected so that the signal line 328 electrically contacts a mating pin in the output port 272 of the accessory device 350. When the accessory device 350 is

powered, a voltage is provided on the output node 365 and to the signal line 328. The voltage on the signal line 328 is detected by the A/D converter 320. A comparator within the A/D converter 320 compares the voltage on the signal line 328 with the reference voltage supplied from the battery source 230 via the third channel 326. The A/D converter 320 can signal the memory 215 for the purpose of matching the voltage on the signal line 328 with a type of accessory. The voltages on the output node 365 of each type of accessory device may be predetermined and stored in a look-up table of the memory 215. Therefore, the look up may list accessory types according to the voltage on a corresponding output node of each accessory type. Once the memory 215 is signaled, the processor 210 may execute software to match the voltage on the signal line 328 with a type of accessory using the look-up table. For example, a modem port may provide a voltage on an output node that is distinguishable from a voltage on an output node of a communication cradle, such as the one shown in FIG. 1. Similarly, a USB cradle or device provides an output node having a distinguishable voltage from the modem port or cradle.

Distinguishing between accessory devices in this manner enables the portable computer 100 to select or alter programming to accommodate one device over another in a quick and cost efficient manner. For example, the portable computer 100 can immediately detect the presence of the USB cradle and alter software to accommodate the USB cradle. This alteration to the software can be done when the portable computer is in a doze-mode, so that the user has quicker access to functions available from coupling the USB device. In another example, the portable computer 100 may be used to preclude inadvertent detection of a modem port, because transmitting or altering programs for a modem port that is not existent can be damaging to the system.

FIG. 4A is a block diagram schematic of another embodiment in which a portable computer 100 is equipped to determine the type of accessory actively connected to it. In this embodiment, the portable computer 100 includes a processor 210, a memory 215, an analog-digital (A/D) converter 320, and a battery source 230. As with the previous embodiment, the processor 210 is preferably a Motorola EZ Dragonball™ 328 that is connected to the A/D converter 320 using an 8-bit connection 312. The memory 215 may store a

look-up table similar to the embodiment of FIG. 3. The A/D converter 320 preferably includes four channels. A first and second channel 322 and 324 of the A/D converter 320 are dedicated for display operations. A third channel 326 couples to the battery source 230. A fourth channel of the A/D converter 320 is used as a signal line 328 to extend to a communication port 232 of the portable computer 100. The A/D converter 320 couples to the battery source 230 via the third channel 326 to receive a reference voltage for a comparator (not shown) incorporated within the A/D converter 320. The communication port 232 also a male pin connector for coupling and electrically connecting with the accessory device 350.

The accessory device 350 includes a voltage divider 460, and an output port 272 for mating with the portable computer 100. As with previous embodiments, the accessory device 350 may include one of many devices, including a communication cradle 150, modem device, or USB cradle. The output port 272 includes a mating pin connector for the communication port 232. The voltage divider 460 includes an input node 462, a first resistor series 464, and a second resistor series 466. One end of the second resistor 466 series is tied to ground 468. An output node 465 is extended between the first resistor series 464 and the second resistor series 466. The output node 465 extends a voltage to a corresponding pin slot on the output port 272. In this embodiment, a voltage of the input node 462 is tied to the battery source 230 of the portable computer 100 via a line 429.

The embodiment of FIG. 4A provides that the battery source 230 to feed the reference voltage to both the A/D converter 320 and to the input of the voltage divider 460. In this way, the voltage on the output node 465 may be adjusted to account for fluctuations to the reference voltage supplied to the A/D converter 320. This enables the A/D converter 320 to more accurately detect the voltage on the output node 465. Additional precision in determining the voltage in turn allows for a larger and more accurate match between detected voltages and corresponding device types. In this manner, the embodiment of FIG. 4A may be employed to distinguish among different accessory types similar to previous embodiments, but more accurately matches the voltage on the signal line 328 with the matching accessory type. Employing an 8-bit A/D

converter 320 in this manner allows for up to 256 different accessory types to be matched to a distinct voltage on the signal line 328.

FIG. 4B is an embodiment similar to FIG. 4A except that the voltage divider 460 is now distributed between the portable computer 100 and the accessory device 350. In this embodiment, the voltage of the output node 465 may be determined based on a resistor series contained within the accessory device 350 that is tied to ground. The input node 462 and the first resistor series 464 couple to the battery source 230 within the portable computer 100. A voltage line 414 passes from the first resistor series 464 through the communications port 232, the output port 272 and into the accessory device 350. The voltage line 414 couples with a second resistor series 464 connected to ground 468 that forms the voltage divider 460. The voltage line 414 may be passed through one of the pin elements of the pin connectors used to couple the portable computer 100 and accessory device 350, such as the second pin shown in FIG. 2. FIG. 4B represents an alternative configuration in which the accessory device supplies a voltage from the battery source to produce a distinguishable voltage on the output node 465. Since the input voltage provided to the accessory device 350 is the same as the reference voltage to the A/D converter 320, the A/D converter is able to better distinguish between voltages on the output node 465.

Algorithm for Detecting an Accessory Device

FIG. 5 is a flowchart showing the steps by which a portable computer device such as the one shown in FIG. 2 operates depending on whether an accessory device such as the communication cradle 150 is actively connected to it. In an embodiment of this invention, the algorithm described herein may be implemented with the portable computer 100 and the communication cradle 150 supplying the portable computer 100. The communication cradle 150 described with this embodiment is intended to only be an exemplary accessory device that provides communication abilities and external power to the portable computer 100.

In step 510, the portable computer 100 receives a signal from the communication cradle 150. This step may be accomplished by signaling to the

processor 210 the voltage on the signal line 205. In step 515, the processor 210 determines whether the communication cradle 150 is actively connected to the portable computer 100. This is preferably determined by a voltage on the signal line 205 being either high or low. In a corresponding embodiment, the signal line 205 floats high and is pulled low when actively connected. Under this configuration, the processor 210 determines that the communication cradle 150 is actively connected when the voltage on the signal line 205 is low.

If an accessory is detected, the portable computer 100 in step 520 alters programming of the software to disable the time-out. To accomplish this step, the processor 210 may execute programming to suspend or delay the time-out feature from turning the portable computer to a state of reduced power consumption. If an accessory is not detected, step 530 shows that the processor 210 will resume normal operations, in which case the portable computer 100 turns off after a pre-programmed duration in which the time-out feature becomes effective.

Algorithm for Detecting a Type of an Accessory Device

FIG. 6 is a flowchart showing the steps by which a portable computer device such as the one shown in FIGS. 3-4 determines the type of accessory device that is actively connected to it. For descriptive purposes, components used to describe the flowchart may be referenced with respect to the assembly shown by FIG. 4, so that the algorithm may be implemented with the portable computer 100 and any one of the accessory devices disclosed herein, including the communication cradle 150, modem device, and USB cradle.

In step 610, the signal from the accessory device is measured. This may be accomplished using the A/D converter 320 to measure the voltage value of the signal on the signal line 328.

In step 620, the algorithm determines the type of accessory by matching the signal value to the accessory type, by for example, using a look-up table. The A/D converter 320 may determine the voltage in counts, and the processor 210 then compares the counts to values stored in the look-up table. The look-up table is preferably stored in the memory 215. In step 620, the processor 210 performs steps of a program according to the type of accessory being connected

to the portable computer 100. For example, the comparator will run a modem application if a modem is detected by the signal line 328, or disable the time-out feature if the communicator cradle 150 is detected.

The portable computer 100 may detect anyone of n accessory types, where n represents the number of voltage counts that the A/D converter can detect. With an 8 bit connection between the A/D converter 320 and the processor 210, the A/D converter may be used to detect up to 256 different types of accessories. Other "types" of accessories that may be recognized by the portable computer 100 include "no accessory", and an "unknown accessory". A possible step 632 shows, for example, that if the voltage count is 0, then no accessory is detected. The portable computer then resumes normal operations in step 642, which assumes battery operation with no accessory device.

The processor 210 may alternatively execute step 634, which shows an "unknown" type of accessory for when the voltage determined by the A/D does not match to a corresponding type of accessory in the look-up table. Subsequently, step 644 shows that an error message is then displayed to notify the user that the accessory device does not match the portable computer 100.

The processor may determine, in step 636, that a first type of accessory device is actively connected to the portable computer 100. As shown by step 646, the processor 210 in step 646 alters the software by performing steps that accommodate the particular type of accessory. In possible steps 638 and 648, the processor 210 detects from one of other types of accessories, and program the portable computer to accommodate the particular accessory.

This invention is intended to encompass an embodiment combining the steps shown in FIGS. 5 and 6. Therefore, under an embodiment of this invention, a portable computer may determine first whether an accessory device is connected to it, and next determine the type of accessory device that is connected.

Alternative Embodiments

Several variations and additional features may be incorporated in embodiments of this invention.

For setting software depending on whether an accessory device such as a communication cradle is actively connected to the portable computer, a switch may be provided that switches the voltage on the signal line from high to low or vice versa. The switch may be used to set a software arrangement for routine uses of the portable computer. In an embodiment, the switch may be used to distinguish between identical communication cradles, where one of the communication cradles is used for a first operational environment, and another of the communication cradles is used for another operational environment. Therefore, a user may assign one of the communication cradles to represent the "home" position, where data is arranged to prioritize personal information over professional information. Similarly, the switch may distinguish the other communication cradle to represent a "work" position, where the data arrangement prioritizes professional information.

In an embodiment of the invention, software on the portable computer 100 may be configured or set to accommodate a particular type of accessory device connected to the portable computer 100 even when the portable computer is a sleep-mode. For example, a modem device may be connected to the portable computer 100 in a sleep-mode. The portable computer 100 detects the voltage on the signal line and sets a data value based on the modem device. When the portable computer 100 is subsequently switched to an "on" or "doze" mode, the portable computer immediately makes the modem device available. Minimizing access time in this manner may provide significant advantages to portable computer s incorporating this embodiment of the invention, in that use of the portable computer is often intermittent and for relatively short durations.

Conclusion

The foregoing description of various embodiments of the invention have been presented for purposes of illustration and description. It is not intended to limit the invention to the precise forms disclosed. Many modifications and equivalent arrangements will be apparent.

CLAIMS

What is claimed is:

1. A method for detecting a type of an accessory device connected to a portable computing device, the method comprising:

detecting an analog signal from the accessory device;

determining the type of the accessory device using the signal; and

executing a program based on the type of accessory device.

2. The method of claim 1, wherein detecting an analog signal includes measuring a voltage level of the signal.

3. The method of claim 1, wherein determining the type of the accessory includes matching the voltage level of the signal with the accessory type from a look-up table of accessory types.

4. The method of claim 2, wherein detecting an analog signal from the accessory includes coupling the portable computing device to the accessory using a pin connector, and designating one pin in the pin connector to detect the signal.

5. The method of claim 4, wherein detecting the type of signal includes using a comparator to measure the voltage level of the signal.

6. The method of claim 1, wherein determining the type of the accessory device includes determining the accessory type from one of at least three accessory types.

7. The method of claim 6, wherein the at least three accessory types includes a null accessory type, an unknown accessory type, and a communication accessory type.

8. The method of claim 7, wherein the communication accessory type includes either a universal serial bus device or a serial data device.

9. A portable computing device, comprising:

a signal line for coupling the portable computing device to an accessory device;

a comparator for detecting a signal on a signal line;

a memory for matching the signal on the signal line with one accessory type from a plurality of accessory types; and

a processor for executing software according to the accessory type.

10. The portable computing device of claim 9, wherein the memory stores a look-up table of accessories that matches the voltage value of the signal line with the accessory type.

11. The portable computing device of claim 9, wherein the comparator measures a voltage value of the signal on the signal line.

12. The portable computing device of claim 9, further comprising an internal voltage source of the portable computing device that supplies a reference voltage to the comparator.

13. The portable computing device of claim 11, further comprising:

an internal voltage source that supplies a reference voltage to the comparator; and

a second signal line extending from the internal voltage source to couple with the accessory device, the second signal line affecting the voltage on the signal line in proportion to the reference voltage when connected to the accessory device.

14. The portable computing device of claim 13, wherein the internal voltage source includes a battery.

15. The portable computing device of claim 13, wherein the accessory is a communication device selected from a group consisting of a communication cradle supplying an alternating current adapter to the portable computing device, a modem, and a universal serial bus device.

16. The portable computing device of claim 14, wherein the processor precludes launching of a program associated with the communication device until an accessory type of the communication device is matched to the signal on the signal line.

17. A detachable assembly, comprising:

one of at least two accessory devices having a distinguishable voltage on an output node; and

a portable computing device adapted to couple and communicate with the accessory device, the portable computing device including:

a signal line that is adapted to couple to the output node of one of the at least two accessories;

a comparator connected to the signal line to detect a voltage on the signal line;

a memory for matching the voltage on the signal line with the accessory device of the at least two accessory devices; and

a processor for altering software according to which accessory of the at least two accessory devices is matched by the memory.

18. The detachable assembly of claim 12, wherein the memory stores a look-up table of accessory types that matches with the accessory device connected to the portable computing device.

19. The detachable assembly of claim 17, further comprising:

an internal voltage source that supplies a reference voltage,

wherein the comparator couples to the internal voltage source to receive the reference voltage, and detects the voltage on the signal line by comparing the voltage on the signal line with the reference voltage.

20. The detachable assembly of claim 19, wherein each of the at least two accessory devices includes a voltage divider having an output node, and wherein a voltage on the output node of one accessory device in the at least two accessory devices is distinguishable from a voltage on the output node of another accessory in the at least two accessory devices.

21. The detachable assembly of claim 20, wherein the internal voltage source supplies the reference voltage to an input of the voltage divider.

22. The detachable assembly of claim 17, wherein an input voltage of the voltage divider is tied to a constant voltage.

23. The detachable assembly of claim 17, wherein the portable computing device mates with each of the accessory devices in the at least two accessory devices with a pin connector having a plurality of pin connector elements, wherein a pin connector element in the plurality of pin connector elements provides the signal line to the comparator.

24. The detachable assembly of claim 17, wherein one of the at least two accessory devices is selected from a group comprising a universal serial bus device, a modem device, and a communication cradle supplying an alternating current adapter to the portable computing device.

25. A portable computing device, comprising:

means for detecting an analog signal from an accessory device;

means for determining a type of the accessory device using the signal; and

means for altering at least a portion of a software implemented on the portable computing device based on the type of accessory.

26. The portable computing device of claim 25, wherein the means for detecting a signal includes detecting a voltage on a signal line that couples to a processor of the portable computing device and to the accessory device.

27. The portable computing device of claim 26, wherein the means for determining the type of accessory device includes a memory which stores a look-up table of accessories that matches the voltage value of the signal line with the accessory type.

28. The portable computing device of claim 26, wherein the means for detecting a signal includes a comparator that measures the voltage value of the signal on the signal line.

29. The portable computing device of claim 28, wherein the means for detecting a signal include an internal voltage source of the portable computing device that supplies a reference voltage to the comparator.

30. The portable computing device of claim 27, wherein the means for detecting a signal comprise:

an internal voltage source that supplies a reference voltage to the comparator; and

a second signal line extending from the internal voltage source to couple with the accessory device, the second signal line affecting the voltage on the signal line in proportion to the supply voltage when connected to the accessory device.

31. The portable computing device of claim 29, wherein the internal voltage source is a battery.

32. The portable computing device of claim 25, wherein the accessory device is a communication device selected from a group consisting of a communication cradle supplying an alternating current adapter to the portable computing device, a modem device, and a universal serial bus device.

33. The portable computing device of claim 26, wherein the processor precludes launching of program associated with the communication device until

an accessory type of the communication device is matched to the signal on the signal line.

34. The portable computing device of claim 26, wherein the accessory device includes one of at least three accessory types.

35. The portable computing device of claim 26, wherein the accessory device includes a null accessory type, an unknown accessory type, and a communication accessory type.

36. The portable computing device of claim 26, wherein the communication accessory type include either a universal serial bus device or a serial data device.

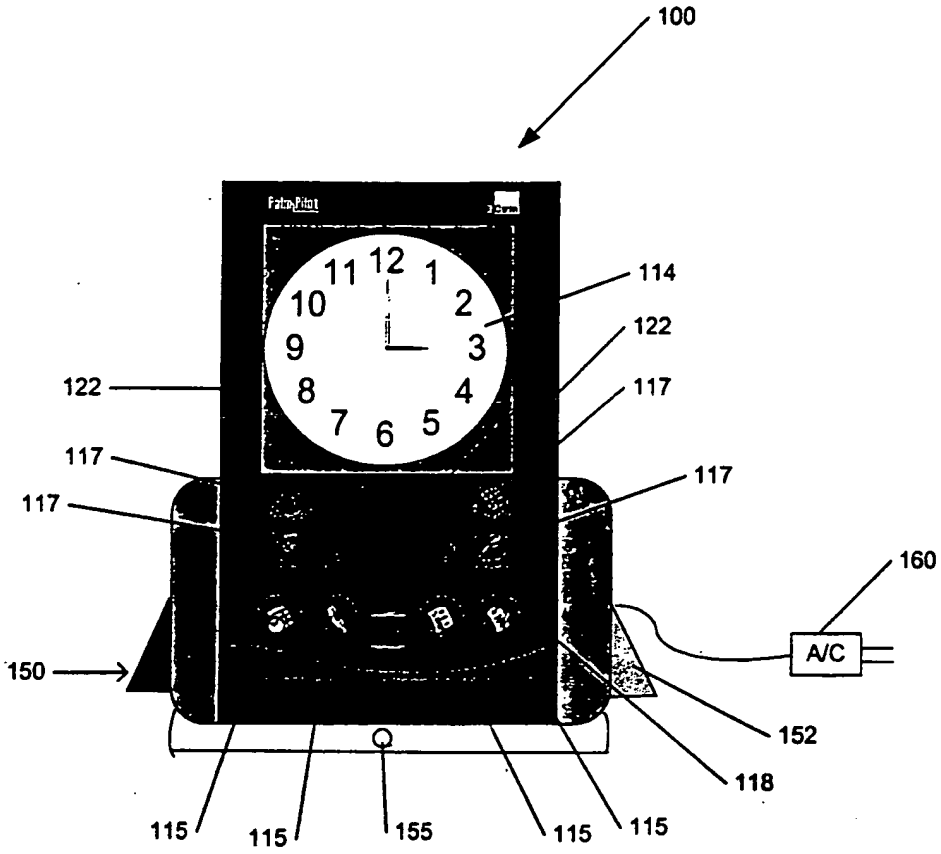
100
114
122
117
122
117
117
117
160
A/C
150
152
118
115
115
155
115
115

FIGURE 1

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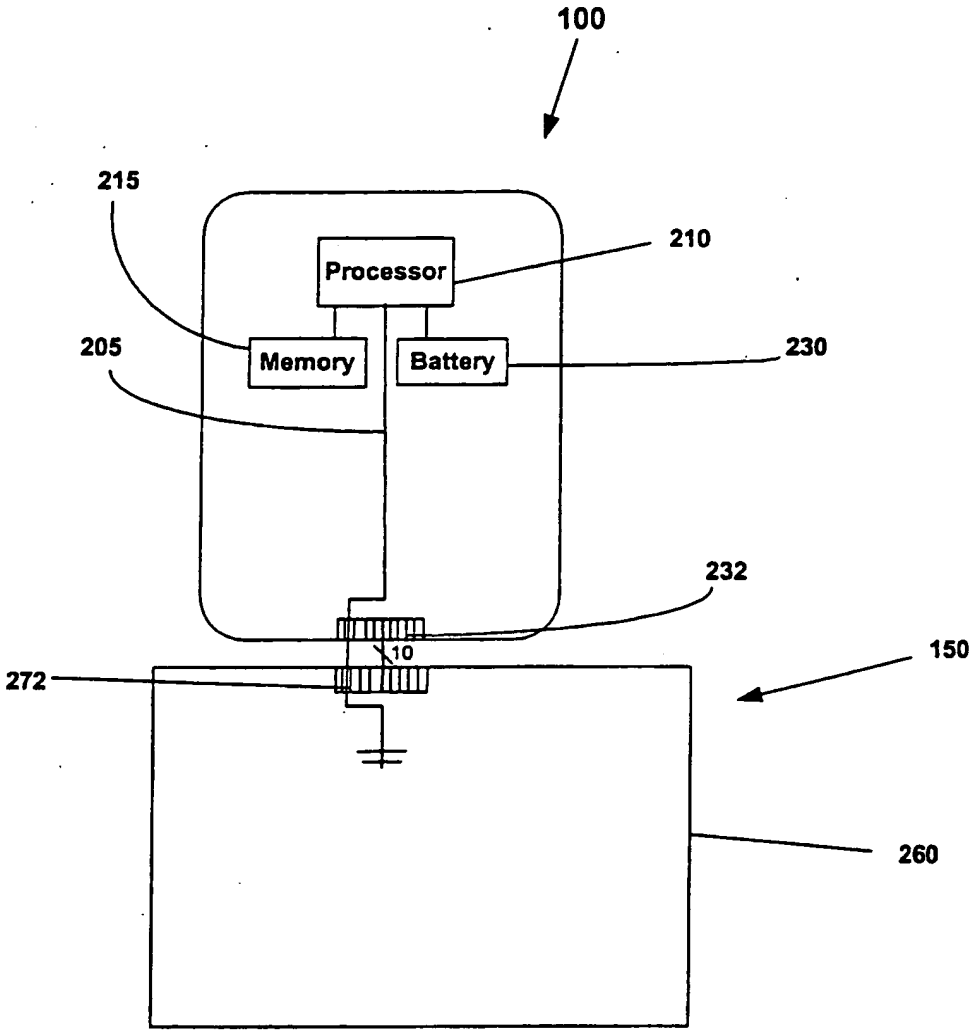
100
215
210
Processor
205
Memory
Battery
230
232
10
150
272
260

FIGURE 2

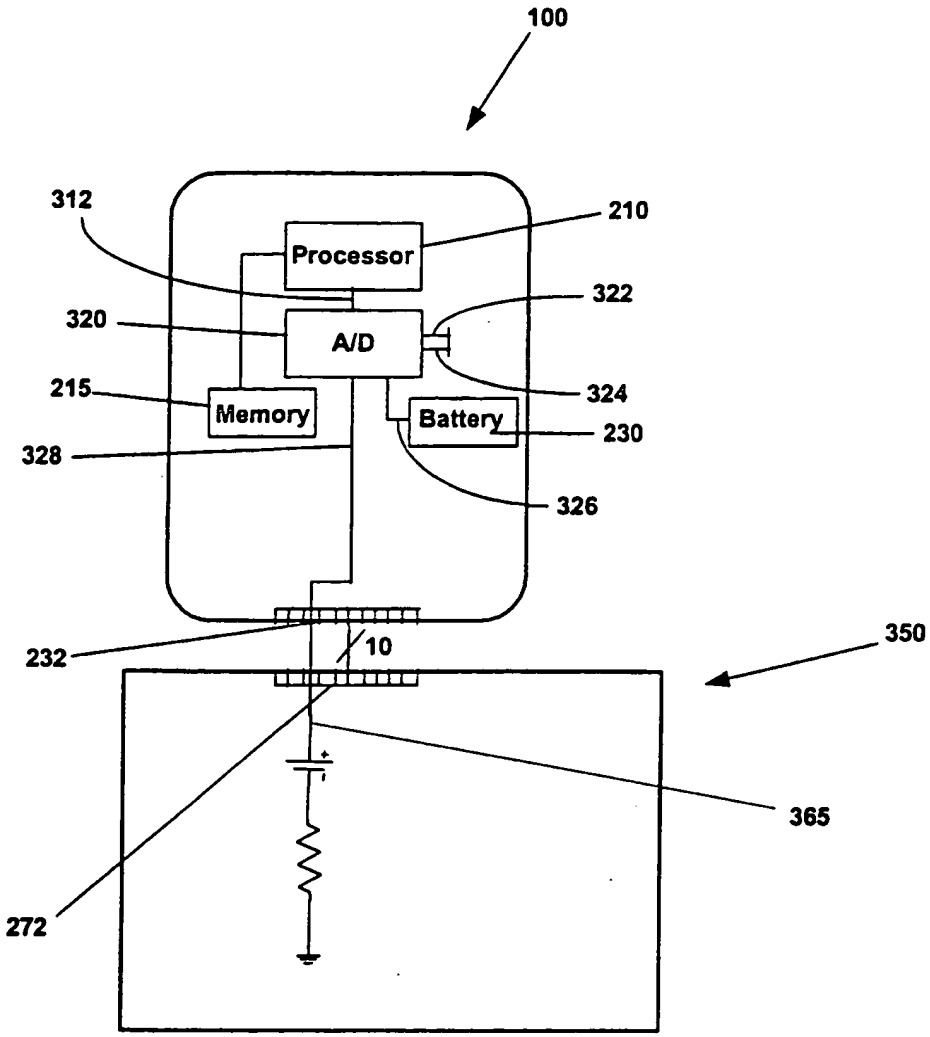
100
312
210
Processor
322
320
A/D
324
215
Memory
Battery
230
328
326
232
10
350
365
272

FIGURE 3

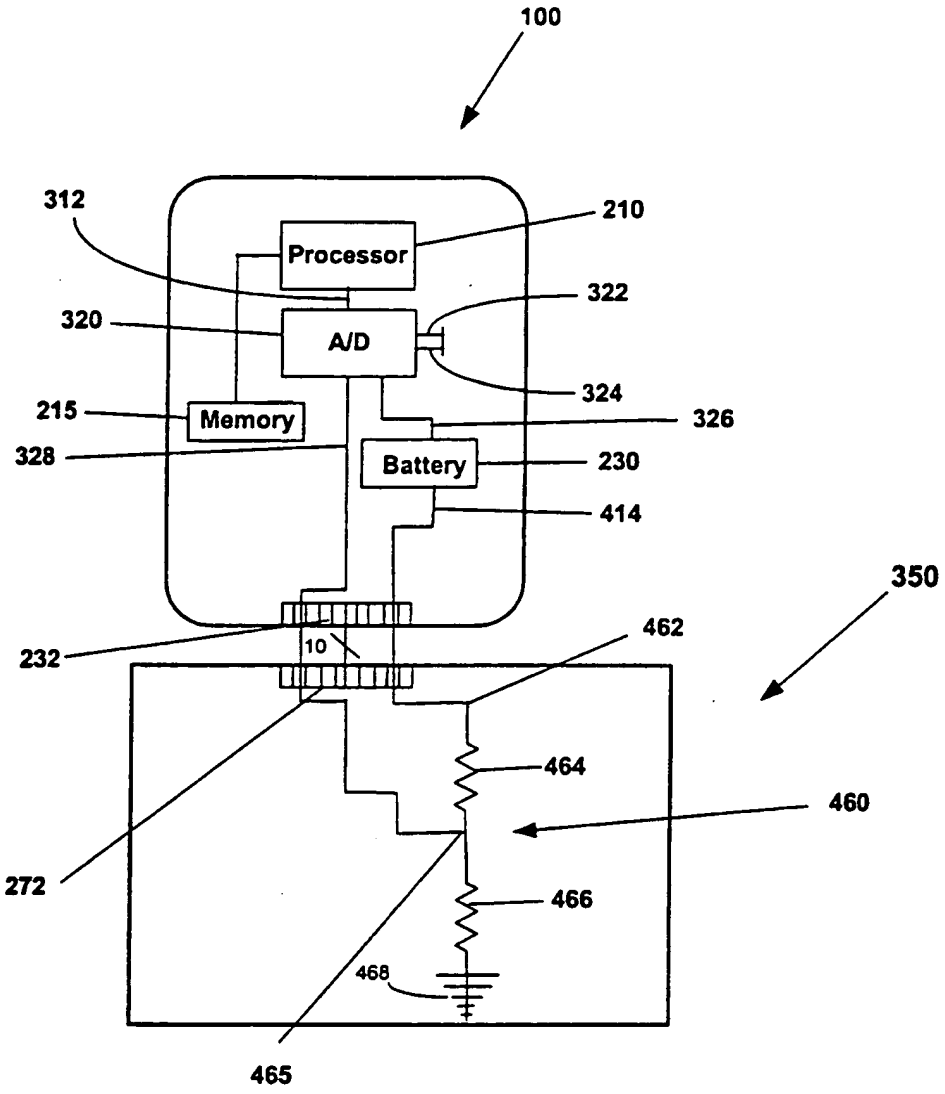
100
312
210
Processor
322
320
A/D
324
215
Memory
326
328
Battery
230
414
350
462
232
10
464
460
272
466
468
465

FIGURE 4A

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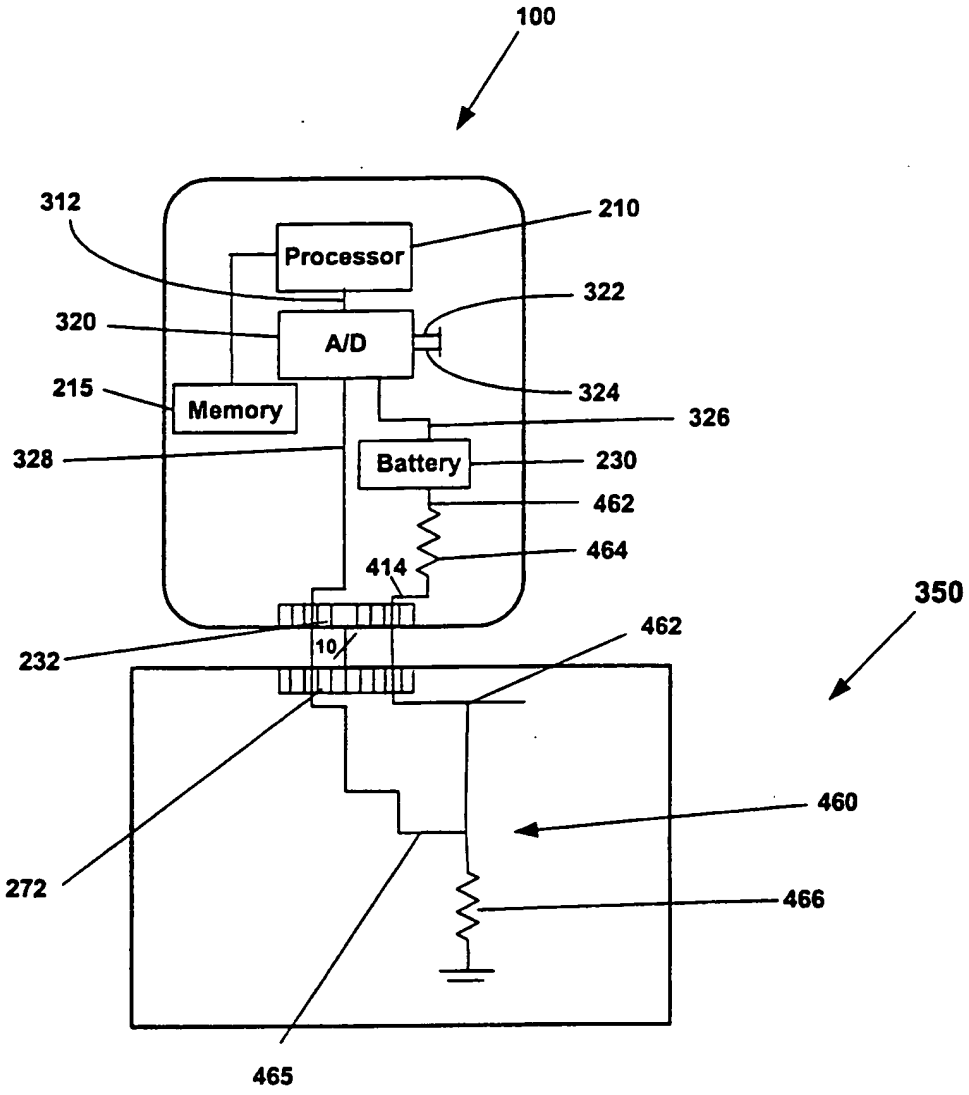
100
312
210
Processor
322
320
A/D
324
215
Memory
326
328
Battery
230
462
464
414
350
462
232
10
460
272
466
465

FIGURE 4B

5/7

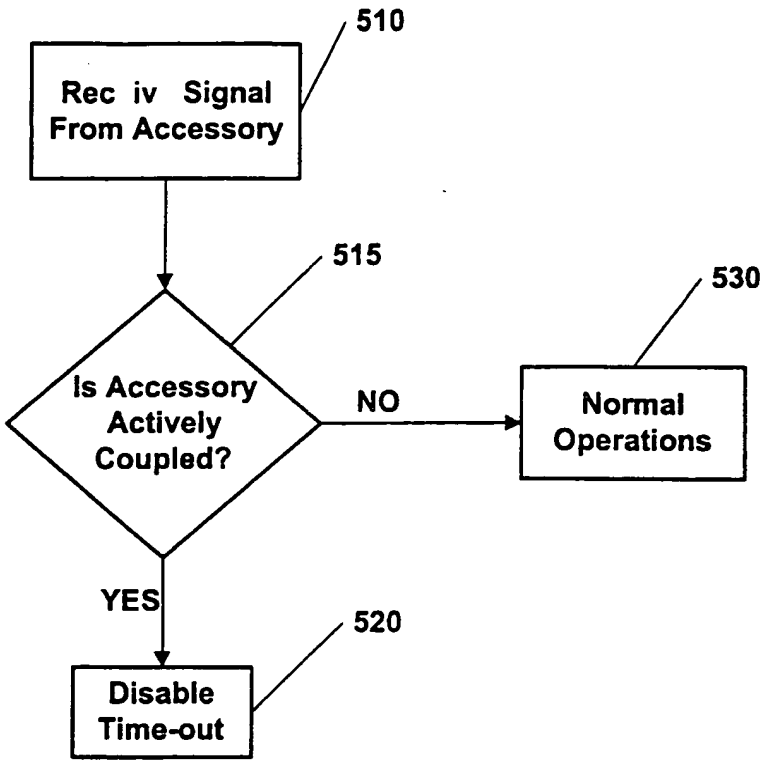
510
Rec iv Signal From Accessory
515
Is Accessory Actively Coupled?
NO
530
Normal Operations
YES
520
Disable Time-out

FIGURE 5

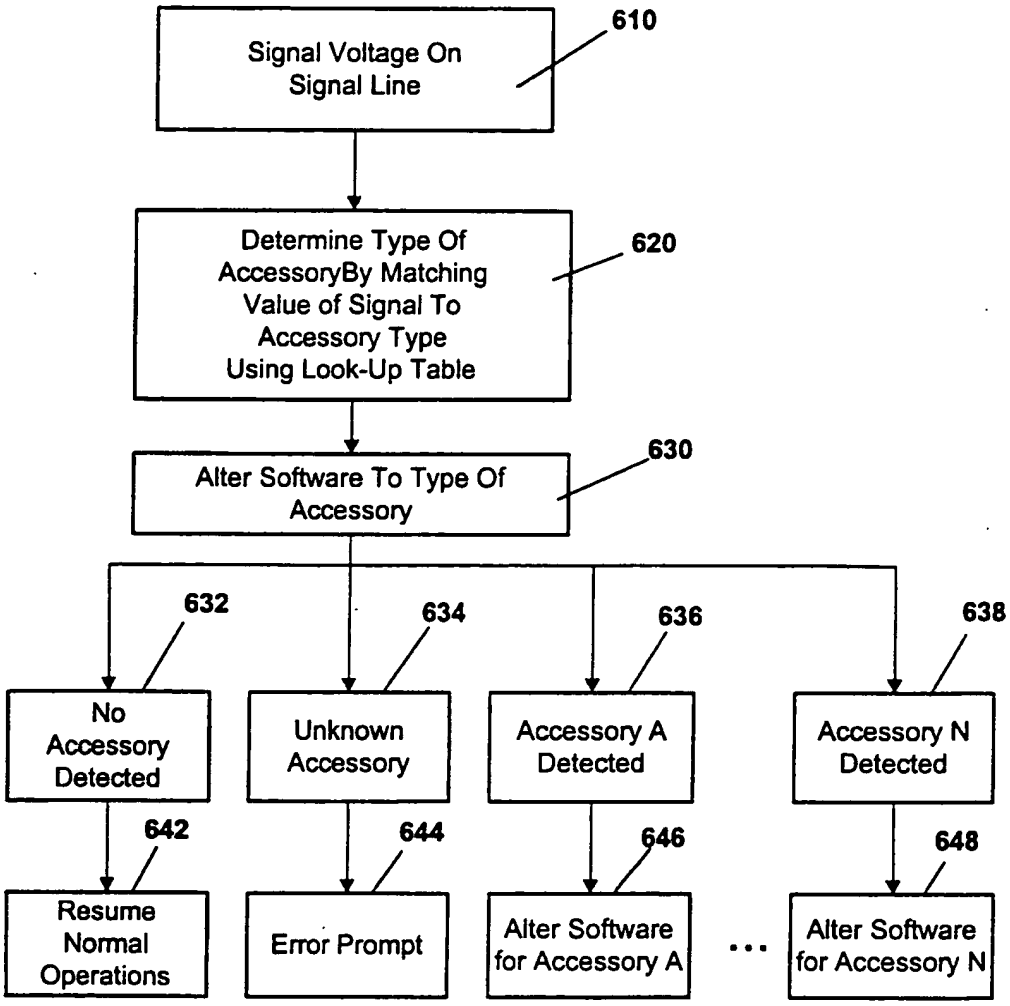
Signal Voltage On Signal Line
610
Determine Type Of AccessoryBy Matching Value of Signal To Accessory Type Using Look-Up Table
620
Alter Software To Type Of Accessory
630
632
634
636
638
No Accessory Detected
Unknown Accessory
Accessory A Detected
Accessory N Detected
642
644
646
648
Resume Normal Operations
Error Prompt
Alter Software for Accessory A
...
Alter Software for Accessory N

FIGURE 6

INTERNATIONAL SEARCH REPORT

International Application No
PCT/US 00/09014

A. CLASSIFICATION OF SUBJECT MATTER
IPC 7 G06F11/00

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)
IPC 7 G06F

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practical, search terms used)
EPO-Internal, WPI Data, INSPEC

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category *	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X Y A	US 5 783 926 A (AGNOR WILLIAM C ET AL) 21 July 1998 (1998-07-21) column 1, line 14 -column 2, line 45 column 2, line 66 -column 4, line 13 abstract; claims 1-3; figures 2,3	1,2,9, 17,25,26 3,4,10, 11 12-16, 18-24, 27-36
Y	US 5 859 522 A (THEOBALD DAVID J) 12 January 1999 (1999-01-12) column 1, line 53 -column 2, line 16 column 3, line 473 -column 10 column 6, line 14 - line 50	3,4,10, 11

-/--

[X] Further documents are listed in the continuation of box C.

[X] Patent family members are listed in annex.

* Special categories of cited documents :

"A" document defining the general state of the art which is not considered to be of particular relevance

"E" earlier document but published on or after the international filing date

"L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)

"O" document referring to an oral disclosure, use, exhibition or other means

"P" document published prior to the international filing date but later than the priority date claimed

"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention

"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone

"Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art.

"&" document member of the same patent family

Date of the actual completion of the international search	Date of mailing of the international search report
29 September 2000	10/10/2000

Name and mailing address of the ISA	Authorized officer
European Patent Office, P.B. 5818 Patentlaan 2 NL – 2280 HV Rijswijk Tel. (+31-70) 340-2040, Tx. 31 651 epo nl. Fax: (+31-70) 340-3016	Nguyen Xuan Hiep, C

Form PCT/ISA/210 (second sheet) (July 1992)

INTERNATIONAL SEARCH REPORT

International Application No
PCT/US 00/09014

C.(Continuation) DOCUMENTS CONSIDERED TO BE RELEVANT

Category *	Citation of document, with indication,where appropriate, of the relevant passages	Relevant to claim No.
A	EP 0 861 008 A (KONINKL PHILIPS ELECTRONICS NV) 26 August 1998 (1998-08-26) the whole document	1-36

Form PCT/ISA/210 (continuation of second sheet) (July 1992)

INTERNATIONAL SEARCH REPORT

Information on patent family members

International Application No
PCT/US 00/09014

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
US 5783926 A	21-07-1998	NONE	
US 5859522 A	12-01-1999	NONE	
EP 0861008 A	26-08-1998	FR 2760163 A AU 5631598 A JP 10276246 A	28-08-1998 27-08-1998 13-10-1998